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VIEWS, NEWS AND INTERVIEWS.

"Those Welsbach gas lights made a good deal of trouble in my family," observed a prosperous merchant. "In my library I have a gas jet set low down over a couch on which I lie and read. I can't get current into my house, so I have to do as well as I can with gas. Hearing of the Welsbach light I ordered my gas man to put one on my reading light over the couch. The other evening I was lying reading, when, as I often do, I fell asleep. The family was out and when they returned I was still asleep and the Welsbach was burning full tilt. I was awakened by a chorus of screams and sobs. My wife and the girls thought I was dead. That ghastly green tinge peculiar to the Welsbach light had cast its effulgence over my countenance and my wife said I looked exactly like a corpse. The Welsbach is gone and I have resumed using the old gas burner while patiently waiting for the electric current to be supplied in my street."

"The earth is the mother of life and electricity its spirit," writes Dr. G. P. Hachenberg, of Austin, Texas, to the ELECTRICAL REVIEW. "Which is pretty, but I don't know what it means," wrote Gilbert, the author of the "Bab Ballads."

"Within a radius of 33 miles of New York city there are 3,500,000 people and 25,000 telephones," said a telephone sharp. "In New York city proper there are 10,500 telephone stations, 90 per cent of which are equipped on the metallic circuit system. In this city the Metropolitan Telephone and Telegraph Company operates 10 central exchanges, seven of which are entirely for metallic circuit service. The New York and New Jersey Telephone Company has 10,000 subscribers, about 75 per cent of whom enjoy the metallic circuit system."

Three hogs in Lexington, Ky., tried to eat a live trolley wire. Two are in the Potter's Field and the third is very ill at his home on Mr. Foster's farm.

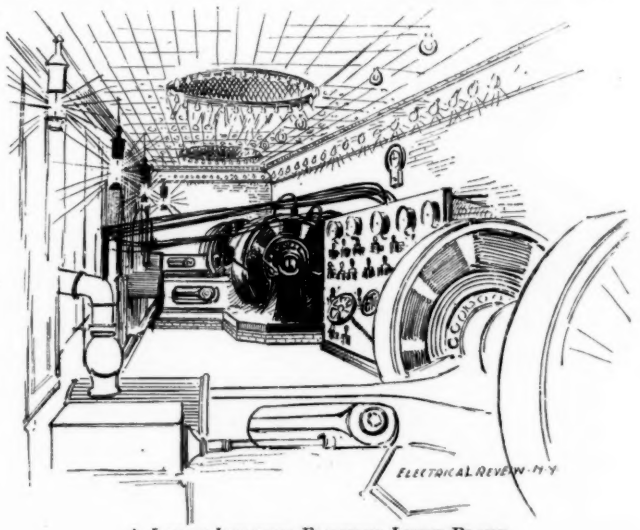
A peculiar accident occurred last week at the crossing of the Pennsylvania Railroad in Camden, N. J. A large can, filled with oil, fell from a farmer's wagon across the track of the railroad and trolley road. A trolley car a moment afterward struck the can, throwing the oil over the car and the tracks. An electric spark from the car wheels ignited the oil, and in a moment the car was aflame. The switchmen at the crossing, together with the car men and passengers, finally succeeded in quenching the flames, but not before the car was badly scorched.

Bowling Green, Ky., is in tears. The horse railway company has suspended operation, and the large number of holders of annual passes will now have to walk. The few remaining residents will continue to foot it as usual, never having acquired the luxurious habit of riding. The suspension of the cars is said to be only temporary, the owners claiming that in the Spring the line will be extended and the cars operated by electricity. But no passes.

Two Kansas City, Mo., electrical contractors have been arrested on a charge of stealing gas by tapping the mains after the gas had been turned off their premises. What, retaliation?

A Large Isolated Electric Light Plant.

One of the largest isolated direct current incandescent electric light plants in the United States has just been completed in the mammoth dry goods store of Hilton, Hughes & Company, New York city. This store occupies the entire block bounded by Broadway, Fourth avenue, Ninth and Tenth streets, and naturally requires a great deal of artificial light. The plant was installed by the New York Electric Equipment Company, having been sold by Mr. Howard A. McLean, of that company. The General Electric Company's apparatus is used, and the ornamental incandescent arc lamps in service were made by the General Incandescent Arc Light Company, of New York city.



A LARGE ISOLATED ELECTRIC LIGHT PLANT.

The plant is located in a very handsome dynamo and engine room on the basement floor. The room is finished in marble tiling and is separated from the rest of the basement by glass partitions, so that the workings of the plant are in full view of visitors and customers of the firm. Power is furnished by four 175 horsepower Payne engines, which drive four 100 kilowatt ironclad General Electric dynamos. There are 500 incandescent arc lamps and 2,500 sixteen candle-power incandescent lights in service. The building is equipped for an equivalent of 12,000 sixteen candle-power incandescents.

A successful test of the plant was made last week when the engines were started by ex-Judge Henry Hilton, of Hilton, Hughes & Company.

THE TELEPHONE QUESTION.

The Effect of the Berliner Decision on the Industry.

OPINIONS OF SEVERAL OF THE ANTI-BELL COMPANIES—THE FEELING IN BOSTON AND CHICAGO WELL PORTRAYED—TELEPHONE OFFICIALS WHO PRESERVE A "GOLDEN SILENCE."—THE CASE IS APPEALED AND A DECISION EXPECTED WITHIN SIX MONTHS—THE LEADING COMPANIES THAT ARE IN BUSINESS TO-DAY—MANY INTERESTING POINTS CONCERNING THE GENERAL TELEPHONE INDUSTRY.

The decree of Judge Carpenter, so promptly announced by the ELECTRICAL REVIEW last week, ordering the patent of Emile Berliner, owned by the American Bell Telephone Company, of Boston, to be delivered up and canceled, created much more excitement than did the expiration of the two fundamental patents of Alexander Graham Bell early this year. The result of the decision is, no doubt, a great disappointment to the Bell company, and will greatly strengthen the many opposition companies that have blossomed forth during the past ten months.

The history of the telephone litigation in this country is voluminous and interesting. The many scores of persons who came so near to making great fortunes out of the Bell telephone will again realize their opportunity and proceed to recite their tales of woe; and some of them will look upon this decision as proper retribution for a company that refused to afterwards compensate them for their ill judgment in those early days.

Through all the great legal battles the Bell company has been successful in the final courts—although by a close margin on the main issue in

the United States Supreme Court—and stockholders of the company point to this record and express the belief that the Carpenter decision will be reversed in the United States Circuit Court of Appeals.

The strength of the American Bell Telephone Company, the ELECTRICAL REVIEW has always believed, lies not so much with its patents as with its magnificent system of exchanges, a chain of companies bound together by the long distance system. Where this does not reach it is strong because of successful occupancy of the field by local licensed companies with rights and franchises and systems that have required years to produce. The patents were chiefly valuable to the parent company in exacting royaltics from its licensees. Here is where trouble will no doubt come, and a noticeable reduction in revenue naturally follow.

Just whether the enormous patent litigation of the Bell company has paid them or not may be questioned. The ELECTRICAL REVIEW was informed many years ago that the company questioned the value of the litigation, and doubted if it was good policy to fight to sustain its patents. But the litigation was entered upon and was uniformly successful, except in this instance—and this has a concluding chapter.

THE NEW COMPANIES.

Since the expiration of the Bell telephone receiver patents early this year there has been a constant organization of telephone manufacturing and construction companies. Several of these had been organized years ago, and they took on a new lease of life when the receiver patent expired. Prior to this time the Western Electric Company, acting under authority of the Bell company, had been for many years the sole manufacturer of electric telephones and exchange apparatus generally. A few acoustic telephone manufacturers had short lives.

Now all this is changed and a host of new telephone companies have been organized with responsible men at their heads. Others not so responsible have entered the field, but not finding a rich and rapid reward have in most cases disappeared.

Among the active companies may be mentioned the National Telephone Manufacturing Company, of Boston; the Western Telephone Construction Company, the Harrison International Telephone Company, and the Gilliland Telephone Company, of Chicago; the Interior Telephone Company (Colvin system), and the Columbia Telephone Manufacturing Company (of which Mr. H. H. Eldred, formerly connected with the Bell interests, is president) have their head offices in New York. In this city is also located De Veau & Company, who have already won an enviable reputation for the excellence of the instruments they manufacture. In many other cities, large and small, manufactories of instruments are coming out. There are now manufacturing companies in Philadelphia and Baltimore, Mianus, Conn., and Kokomo, Ind., in Richmond, Va., and New Brunswick, N. J.

The above list is given as the names readily come to the mind of the writer and only partially tell of the sudden revival of a business that a few short months ago did not exist outside of one large factory. Besides, many of the general supply houses are either manufacturing or handling telephones, and several have equipped entire exchanges in the smaller cities.

The Drawbaugh interests are again in the field, and a Philadelphia syndicate owning the Clamond patents is said to have deep and extensive plans laid for business in this field. If this be true, the P. s. should now hold up its right hand.

PRESIDENT COLVIN REVIEWS THE SITUATION.

Mr. F. R. Colvin, president of the Interior Telephone Company, New York city, being interviewed by a representative of the ELECTRICAL REVIEW, made the following statement:

"Touching the decision in the Berliner case we were in a position to win either way. Had the American Bell Telephone Company won the case it would have left us with the only non-infringing battery transmitter on the market—the only one using no induction coil and not depending in its operation upon 'variable pressure between electrodes in constant contact.' Our transmitter has been shown by 120 tests made by Messrs. Houston & Kennelly to have an average possible difference of resistance of twenty-seven to one, due to variable surface relations only—the pressure being an absolute constant. One transmitter under one condition of surface having a resistance of 600 ohms showed in another relation of surfaces and with identically the same pressure a resistance of 80,000 ohms. However, these are matters that are not adequately understood by the general public. The first effect the decision will have will be to remove public apprehension respecting the use of battery transmitters. This will greatly improve the general telephone market. It will also start a

(Continued on page 330.)

ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS DECEMBER 19, 1894, BY LUDWIG GUTMANN.

Since the first announcements of Professor Ferraris and Mr. Tesla that rotation can be accomplished by employing two or more alternating currents of displaced phase, the question has been raised by many an engineer as to the possibility of producing a rotary magnetic field by the use of a single circuit, carrying the ordinary alternating current, instead of requiring three or more wires or several independent circuits. So far it has been necessary to construct a special generator armature, the windings of which were rotated in a field of constant polarity, to produce two or more currents lagging in phase behind each other. To use the currents generated for establishing a progressive or rotary field it was necessary to carry as many wires to the place of consumption as currents were employed differing in phase. Six years have passed, and quite rapid progress has been made in various directions. I wish now to bring to your notice a method of generating a rotary magnetic field by a single alternating current or its field without condensers or choking coils. This is accomplished by a device brought out by me some three years ago. Its fundamental principle is hardly as yet appreciated. However, the World's Fair exhibits, as well as literature of late, show that the device has attracted attention, and that several engineers have approached the principle involved.

I wish to refer to my motor and especially to its armature, described in 1891. Figs. 1 and 2 show the device. The former is principally used in the American patents, while the latter is given in the English patent of the same year. The novelty of the armature construction lies in a winding containing closed sub-circuits, and another point is that the closed circuits do not coincide in number with the poles of the field magnet. Before going into the action of this device I will mention two simple experiments which are essential in order to understand the operation of this rotary magnetic field system.

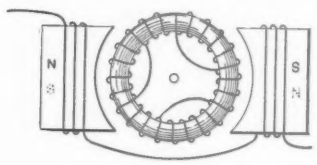


FIG. 1

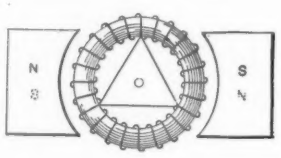


FIG. 2.

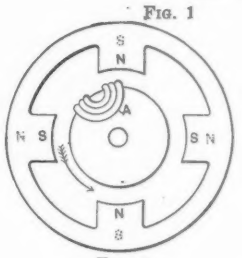


FIG. 3.

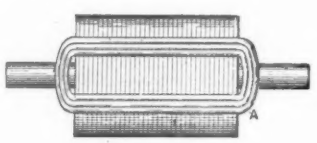


FIG. 3a.

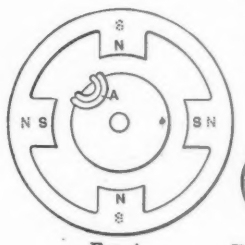


FIG. 4.

FIG. 5.

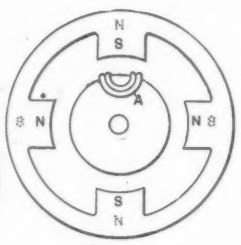


FIG. 6.

FIG. 7.

FIGS. 1-7.—ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

If we have a closed coil moving in an alternating magnetic field, or better, between the poles of a field magnet, as illustrated in Figs. 3 and 3*a*, energized by alternating currents, then the coil A will be repelled from the pole, owing to the secondary field which it establishes, so long as it cuts, or is threaded by the lines of the force of the field. The consequence is that it will rotate and place itself between the north and south pole, Fig. 4, where it reaches a stable magnetic equilibrium, as I like to term it, because in this position it acts like a pendulum properly suspended (Fig. 5). Any motion imparted causes the pendulum to make a few oscillations and come to rest, and similarly any attempt made to move the coil into an energized field will cause it to be repelled, and after a few oscillations it will remain at rest between the poles. It is repelled in either direction, because as soon as it approaches a strong magnetic flux, currents are induced in its windings and create an opposing field. The same coil can be in unstable magnetic equilibrium (Fig. 6), if it stands just in front of a pole, in which position it would act like a pendulum which is balanced with the weight above the point of the support (Fig. 7). Both are in unstable equilibrium; the least motion to the left or right imparted to either will cause them to accelerate in the direction of the impulse, and to assume a position of stability (Figs. 4 and 5). In this position, Fig 4, the coil is therefore currentless. This stable position is the natural position of synchronous motors in operation.

If such a synchronous motor is held behind the phase when rotating under load, a heavier current is induced in the spools which accelerate the armature and keep it in step. If, however, the motor runs in harmony, and suddenly a great deal of the load is taken off, then the armature has a tendency to go more quickly, but in this case opposing currents are generated in the windings, which retard the speed of the armature and keep it back, to remain in step or in stability.

Let us look into the device before us and consider first its quality as a motor. Returning to Figs. 1 or 2, preferably the latter, which is simpler and easier to explain, we find that if we send into the field magnet coil an alternating current, the armature will turn through a certain angle and stop. This motion depends upon the position of the three closed coils with respect to the two poles. This same device can itself be self-starting if we make the poles far enough apart and the energizing current sufficiently strong, so that at the initial speed the armature is repelled at a certain rate. This initial speed changes with the number of poles, closed circuits and alternations. Let us take the first case and examine it. If we try to rotate the armature (as I shall call it hereafter) in a field of alternating polarity, we induce currents in the closed circuits, which establish poles, but these poles are alternating in nature, and owing to the motion imparted, and owing further to the permanent connections in the winding, the poles move or travel with the latter. This accounts for the fact that if the field poles are close together the armature consumes power during its rotation through the alternating field; it acts as a dynamo and does not start from a state of rest. If we impart by mechanical means an impulse to the armature, currents are generated whose sum has a variable

and principally negative value. The armature makes a few revolutions and places itself in a stable magnetic equilibrium; viz., in such a position, symmetrical if possible, as not to generate any currents, and hence not to induce any reactionary* poles in the core. If, however, we impart to this armature a certain initial speed, which I shall call the critical speed, then it will continue to rotate, with a tendency to reach a certain fixed higher speed. This initial impulse may be given by mechanical or electrical means. I shall not state the results as yet, but prefer to explore the action first, so that the same may be before us in various diagrams, and enable us to make any deduction desirable. First, let us assume that the armature rotates synchronously: it is evident that in order to have an armature with three close-circuited coils, interconnected as shown, rotate in one direction, we must have currents induced whose sum has a positive value; viz., two of the coils must do work, in the same sense, while the third coil is either without a current, or has a smaller current in opposite direction, so that the value still remains positive. For true synchronism a close-circuited coil reaches within a half-period the opposite pole, and consequently our diagram for one revolution would look as follows: (See Fig. 8.)

The three diagrams, *a*, *b*, *c*, show the flow of currents and resultant poles. The close-circuited coil 2, diagram *a*, is at this moment generating opposing currents to the others; coil 1 is passing just in front of a pole. All three induced currents combined are developing poles as indicated, and rotating the armature in counte· clockwise direction. The rotation being synchronous, diagram *b* shows the position of the armature when the polarity in the field has reversed; diagram *c* gives the position of the coils after the polarity has changed again. It will be noticed that the original position, as shown at *a*, has been reached again and that the cycle will repeat itself. Without explaining these diagrams at this point, I wish to bring before you several other conditions, all of which will assist in reaching definite conclusions. Looking at the armature we see that it has a symmetrical winding, and as long as these closed circuits do not coincide with the number of poles of the field magnet (contrary to all synchrous motors built heretofore), other working positions are possible. The operation will take place as long as the sum of the armature currents have a positive value, since as far as the rotation is concerned it is indifferent which of the coils are doing the work. Let us assume that the armature does not run at a synchronous rate, but at another fixed speed which may have a certain commensurable relation to the periods of the exciting field current, which speed I shall call the harmonic speed. Instead of showing the diagram with windings as in the first set, I have simplified them. In the following sets of diagrams, Fig. 9, I assume that the armature, on account of the load or other reasons, cannot reach synchronism, and that at each field reversal the position of the armature with respect to the field is the same, only the coils have changed places as indicated. You will notice that in this set of diagrams the armature, for each half-period, makes one-third of a revolution only; namely, coils 1, 3 and 2 exchange positions with the change of polarity. Let us step at once to another speed (Fig. 10), which you will no doubt admit as possible; viz., let us assume that coils 1, 2 and 3 cannot arrive at synchronous speed, and that coil 2 reaches the position which 1 ought to occupy, it will be seen that owing to the symmetrical position, it is quite indifferent which of these coils arrives at a given position required for harmonic operation. This will be clear to you by referring to the third set of diagrams, Fig. 10.

We are now enabled to compare three sets of diagrams, Figs. 8, 9 and 10. The first set shows for this new type of synchronous motor that at synchronous speed the pole positions in the armature are practically stationary relatively to the coils and core, and rotate with it. The second set shows that during a complete revolution of the armature, the field has reversed three times, that is, an odd number of times, hence, when the armature returns to its original position, after a complete revolution, it finds the field magnetization of reversed polarity. The magnetic field of the armature rotates in the opposite sense, one and a half times per revolution. In the third set, the armature makes but one-sixth of a revolution per half-period, and the magnetic field of the armature in a complete revolution rotates three times in the opposite direction. This statement may be startling, and my argument, so far, may not be entirely convincing, as on close inspection it will be found that the armature poles have to do considerable jumping. I will now explain the performance of the rotary magnetic field of this armature in a four-pole field, where the changes occur far more gradually, leaving no doubt whatever as to the assertion made. Fig. 11 shows diagrams illustrating synchronous speed. By the aid of these four diagrams we can more easily follow the pole position in the armature core, and find them stationary in it. Inspecting now Fig. 12, in which the armature speed is reduced, we are able to obtain a clear picture of the main subject under consideration.

In this set of five diagrams we see five positions, which coil 1, for instance, occupies before it has made one-third of a revolution. Nevertheless, if we now look at the changing pole positions we can readily detect that they are progressively shifting, and we also see that they have made one whole revolution and that in opposite direction to the mechanical rotation, or, in other words, the magnetic field would travel three times around the armature core during one revolution. In all armature diagrams described and to be described the resultant of the magneto-motive forces of the armature currents is given only. To complete the picture showing every one of the component magneto-motive forces acting, it becomes desirable to plot a diagram of force (Fig. 13). These components act like three variable concurrent forces, including an angle of 120 degrees with each other. These forces we may represent as equal, for the sake of convenience, as it does not influence the idea which we wish to illustrate. However, those two forces which are acting in the same direction are indicated by heavier lines.

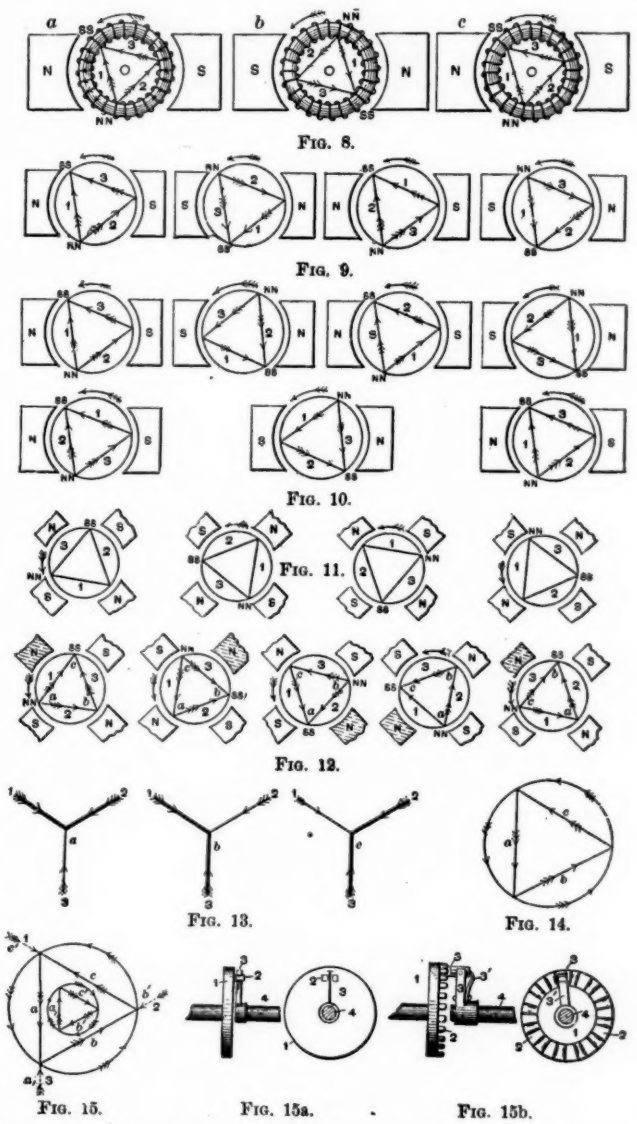


FIG. 8.

FIG. 9.

FIG. 10.

FIG. 11.

FIG. 12.

FIG. 13.

FIG. 14.

FIG. 15.

FIG. 15a.

FIG. 15b.

FIGS 8-15b.—ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

Plotting the direction of the forces in order, as, for instance, in the last named set of diagrams (Fig. 12), where the coils act in the order 1, 2 against 3; 3, 1 against 2, and 2, 3 against 1, we obtain Fig. 13 for one cycle. The three figures marked *a*, *b* and *c* indicate the direction in which the three forces are acting in the three positions of one cycle or revolution.

By drawing the resultant diagram of force from the predominating forces of each position, we obtain the accompanying figure (Fig. 14). These forces form a triangle, and the rotation resulting may be seen from the direction of arrows on the circumference of the surrounding circle. However, the reactive forces should be considered and represented separately to obtain the true picture, and we have to add them to find the total force applied and the manner in which all the forces are acting. We therefore repeat the resultant diagram (Fig. 14), and add the opposing forces at their proper places. This diagram (Fig. 15) shows that the reactive forces, shown by dotted arrows, also have a common center, and that as regards time of maximum effect, they succeed each other in the direction of rotation of the armature, while they are acting in the opposite direction of the main force. If we now plot a diagram of these reactive forces alone, we obtain the smaller triangle shown (Fig. 15) inside the larger. It will be noticed that rotation is in the opposite direction; or, in other words, that in reality we have, with this disposition, to deal with two rotary magnetic fields in opposite direction; the useful work done will depend on the difference of the angular velocity of these two rotating fields and their relative intensity.

Looking now at the device as a generator (Fig. 12), we can account for the rotary magnetic field because we generate polyphased currents in the coils 1, 2 and 3. They operate together in the following order: 1, 2; 3, 1; 2, 3; 1, 2, etc. If rotated as shown the coils will distribute three-phased currents over the armature, and this will be understood when examining into the flow of currents of the close-circuiting conductors which are here provided with arrows. At this particular harmonic speed it will be further noticed that the simple alternating field of force has the identical qualities as a polyphase energizing field, as the poles in front of the close-circuited coil seem to be traveling (for the armature) in clockwise direction. This is indicated by the shading of the pole of the same sign in front of the coil most powerfully acted upon in the five positions, representing one revolution for the field. The currents displaced in phase cause the armature to rotate harmoniously with the alterations, and prevent the armature from being easily thrown out of step.

(To be concluded.)

*It is well to call the armature poles, due to the armature currents, reactionary poles. The other armature poles are induced directly by the field poles, and contribute nothing to the torque.

A Three-Cent Street Railway in Detroit.

Considerable Cleveland, Ohio, capital is interested in the new street railroad company which recently secured a franchise and is being formed in Detroit, Mich. Those interested are Henry H. Everett, Charles L. Pack, Green Pack, Albert Pack, Charles W. Wason. It is called the Pack-Everett Company, the Detroit capital being represented by Green Pack, Albert Pack and others. Work on the lines of the company will begin at once, and cars will be operated on a three-cent fare.

DIRECT CURRENT MOTOR AND DYNAMO DESIGN.

A LECTURE DELIVERED BEFORE THE NEW YORK ELECTRICAL SOCIETY, NOVEMBER 27, 1894, BY GANO S. DUNN.

DISCUSSION.

Dr. Charles E. Emery: I have been very much interested in what has been said here to-night, and very much pleased with the very clear and thorough way in which it has been expressed. I have had some perhaps unusual opportunities to investigate these particular matters and have been surprised at the want of candor of very many in speaking of these subjects, particularly in relation to sparking. Very many would be surprised to know the numerous theories there are on the subject even among those who have written books on the subject. Now, that it has come down, as I had fully made up my mind that it would, to the two points of the forced commutation and the induction, as has been so fully described to-night, it is certainly very gratifying to have it put forth so clearly and without the least attempt to make a mystery of it or to conceal anything. The young gentlemen here present may be very much gratified at having the whole matter, in a sense, thrown open to them.

There is still another point that is directly in this line, although led into it from a different direction. On account of my connection with large tests, etc., and having recently taken up the study of electricity, I was appointed chairman of a committee at the Exposition to make tests of the large engine dynamos. It is well now to state one point in respect to those tests, one real discovery, I think. In ascertaining the efficiency of a dynamo it is very common to obtain the core loss and friction of the engine light, then to excite the fields and obtain the armature drag by subtracting the second set of observations from the first. Now the two quantities thus obtained it is very customary to use as the armature drag and the friction throughout the whole range of the experiments. Those experiments showed very clearly that that is incorrect, for the very reasons which the lecturer set forth here to-night, the armature drag increases quite materially as the load rises. The exciting force is necessarily increased first to balance the drop through the coils, to balance the lost volts, it is sometimes called. But there seems to be some reaction there independent of that. At any rate, summing together the energy used in the shunt and series fields, the amount increases in a very much larger ratio than the power. That necessarily increases the armature drag, and so there was no way of balancing the indicated horse-power with the electric work but by taking that into consideration, and it shows very plainly that the proper way to make tests in cases of that kind is by separate excitation, or by putting on more shunt field, without using the series field to make a series of progressive tests and bring up the voltage by the increased field and find the losses when the armature circuit is open for each of those progressive loads, and then those subtracted from the full load, or added together and compared with the external output, really give the efficiency. The efficiencies of these standard machines are lowered by this method, and it is one reason why we find in practical circumstances that those large efficiencies are not obtained. It is not very great, but when we come to these new machines a matter of two or three per cent is considered very large, and there is that difference to be accounted for in that particular way. There is one other matter, when others have discussed the subject, to which I will call Mr. Dunn's attention, and that is that in his first diagram he told us why the characteristic took the form. Now we possibly can study out why the other characteristic took the form. But he did not happen to mention it. I do not know whether he intended to or not. We should be happy to hear it if he wishes to explain the matter.

Mr. Tesla: The lecture which we have just listened to has been to me, I can assure you, a great pleasure. I cannot but congratulate professors of Columbia College to have such a pupil who is able to so address an audience on this subject. I remember that, in these halls, I presented some years ago my first work on high frequency phenomena, and it was Mr. Dunn, who first of all the students here, aided me, and I remember how I felt, as he no doubt has felt this evening in addressing for the first time an audience, and I remember how grateful I was to him for the assistance he gave me at that time. It has been a great pleasure to me to be here, not only because I have had this evening's enjoyment, but because I have felt that my first idea of Mr. Dunn was a correct one, and that we may expect from him valuable work. (Applause.)

Dr. S. S. Wheeler: As Mr. Dunn has touched on the subject of regulation of dynamos, we might try to induce him to speak of the regulation of dynamotors. I think that is an interesting subject, though it does not properly belong to this one.

Dr. Geyer: Mr. Dunn explained very lucidly the matter of brushes of various resistances, and that we are between two difficulties—of getting too high resistance; or, if the resistance is too low, getting too much sparking. I was going to ask if he knows of any brushes being used that were individually graduated—to have, say, a good conductor for a foundation and a brass conductor over it for your next grade of conductivity, and so on worse and worse—say that the thickness of your brush was copper, brass, good conducting carbon, poor conducting carbon.

Mr. Dunn: I will answer first Mr. Emery's question concerning the shape of this second curve which was drawn. The curve was shaped like this. The fact that the curve B does not rise as high as the curve A at that point is due to these two reasons: The B motor is expected to give 300 per cent load for short periods without sparking. Therefore, in the first place its shape is very large and strong and tough and its bearing friction is large; also its commutator has to carry very heavy currents. Then again, in order to be sparkless, it has to be a machine in which there is a great deal of iron and very little copper, a great many lines of force in the armature and very few turns on the armature to distort those lines of force. Therefore, the hysteresis is large and the eddy currents are large and the field, in order to go around such an amount of iron, is also large. That makes the fixed losses very large, and for small loads, such as this, the fixed losses bear so small a proportion to the total output that the efficiency is small. As the losses that increase with the load are small with this type of machine they do not come in and cause the curve to bend down as it does here, and so the curve rises up to this point.

With regard to the brush mentioned by Professor Geyer, such a brush is the Worth brush, which is made up of copper leaves in the middle separated by paraffine paper, then a lamina of some other material of higher resistance than copper, then lamina of some other material higher yet, all separated by paper. Those brushes are excellent for low voltage machines, but for high voltage machines even the resistance of German silver is not enough to cause the forced commutation. With regard to making the carbon in different resistances throughout, that would unquestionably secure the end that Professor Geyer suggested, but these carbons are made out of a mixture that looks like molasses — very thick clay. It is liquid almost, and it would be difficult to properly make those together, and it would be much easier to make a brush of high resistance material all through and make it so much wider. Widening the brush would have the same effect as making the parts of higher conductivity.

With regard to the regulation of dynamotors, the dynamotor is a machine in which the armature is wound with two windings, one of which drives the core, and the other of which, by passing through the same field, generates the electro-motive force and acts as a dynamo. You cannot change the dynamo voltage, because, while it gives you more lines of force to be cut, yet it makes your motor go just that much slower. To make a motor dynamo which regulates, you must have it arranged so that all the lines of force that act on your motor do not act on your dynamo. Then by varying the lines of force that act on your dynamo only you can get a variation of voltage such as that by simply connecting together a motor and dynamo, then by varying the fields of the dynamo only, a rise of potential can be secured. It is also done in this way: The motor windings are here. The dynamo winding, instead of going as I have drawn it, may go out on a little additional core out here, and then a little extra field magnet similar to this can inject lines of force into this little core, and those lines of force will have an effect on the dynamo field.

Mr. Perry: I would like to ask Mr. Dunn in regard to a device which we all saw at the electric building, which was presented by one of the German exhibitors and in which a polar ring was used. Herr Oltenheimer, who was in charge of it, spoke of it very highly, and I believe it was attributed to Dobrovolski. One of the claims that he made for it was that it would stop sparking, but I have seen that machine spark quite as violently as machines without the polar ring.

Mr. Dunn: The principle of the Dobrovolski magnetic shunt is this: If we have a four-pole machine—now we want to get a fringe, say at that pole, to stop our sparking. Now in very intense fields if we move our brushes till we get just there we will get the right amount of fringe to reverse. If we move them a little bit too far we will get so much more fringe than is necessary that they will spark very badly, and if we do not move them quite far enough we will not get enough fringe to reverse. In other words, the entrance of the brush under this fringe is too sudden. That fringe is reacted upon by the armature reaction, and if when the brush is under the fringe the load should be removed, which allows the fringe to come back, it would come back and lap over that point of commutation a little bit, but would cause a sparking. Mr. Dobrovolski puts inside his armature a thin layer of cast iron. At first sight it would seem that that cast iron tube would cause a large amount of magnetic leakage from pole to pole and be of no value; but he bores it full of holes right in the middle so that he does not cause much leakage, and it has the effect of causing a gentle distribution of this fringe all the way across here. But if there is much of an armature distortion the fringe that has been driven away has to come a long distance to get back. In other words, it makes an equable distribution there and helps your commutation. As to how effective that device is I do not know. I should think that for machines in which the coils are not slipped right over the pole-pieces, about the same results could be accomplished by chamfering off the edge of the poles and properly shaping them.

Mr. Emery: Perhaps it would be of interest to those present if the speaker would explain the Sayre winding.

Mr. Dunn: The Sayre winding. On this diagram there is not going to be any fringe out there to affect the electro-motive force in the coil when it gets under there, because it is too far away from either of the magnets. Now, if I shift this brush backwards and cause the commutation to take place under that point or that point, I have shown how it weakens the field very much. Now, the principle of Mr. Sayre's device is that, in this little lead here which is going up, before it is allowed to touch the windings, it comes over here, and in a separate winding wound on the same core just wraps itself around there a few times and then goes back and then goes up. Now, with the brushes in this position, that little winding which is over here generates the electro-motive force which is necessary to cause this coil to reverse right where it is without the necessity for shifting the brushes. Another point in Mr. Sayre's winding is that, by putting this little coil over there, he can put that little coil there, which is the weak pole horn, or he can put it there and wind it in the opposite direction, and it would have the same effect. Now, this would naturally be the weak pole horn, but that little coil by going there can be made to strengthen the magnetism here. You notice how this machine sparked when it ran backwards. Now, Mr. Sayre uses that reactive field to create his whole field. It is a very complicated winding, and has not as yet been used in practice that I know of, not certainly to any great extent. It requires two different windings: the regular winding to do the work, and then this secondary set of windings in each of these little commutator wires to do the reversing. But the principle of it is splendid.

Dr. Emery: I recently had a letter from one of the representatives of the General Electric Company in England who has been investigating the matter, and he said that it overcomes a great deal of the difficulties of the designs of dynamos. The winding, although complicated as spoken of, can be of very small wire, because the separate coils only come into connection as they come under the brush and therefore they have time to cool until they can come under, so that although I was not impressed with it at first, there is a second paper of Mr. Sayre on the subject in which he has put them into a great number of machines and reduced the size very materially. It was not necessary to have even as much iron in as before. He did not pay any attention to this question of armature reaction except with the coils, and took it all out, and in that way was able to reduce the weights very materially and yet accomplish the results very satisfactorily.

A Member: I would like to ask about the exact ratio between the width of the slot and the size of the air-space.

Mr. Dunn: That ratio in a machine as small as this, when the air-gap is one-eighth of an inch, may be three-eighths without very much loss, but if it is made a quarter the loss is insignificant. Two to one is a good ratio in small machines. In large machines the width of the slot is made equal to or a little less than the air-gap. But in small machines like this the width of slot twice the length of the air-gap gives no trouble. The loss due to it is perhaps one-half of one per cent.

Dr. Emery: If there are no further suggestions I would like to express my own thanks for the very able manner in which this subject has been presented by one that we have learned to admire, and I wish to move a vote of thanks to the lecturer of the evening for his very able and interesting lecture.

The motion was carried, and the meeting adjourned.

COMMUNICATION FROM DR. WHEELER.

To the Editor of Electrical Review:

Dear Sir—During the discussion of Mr. Dunn's recent lecture before the New York Electrical Society, at Columbia College, on the "Designing of Electric Motors," I understood Mr. Tesla, in a very neat speech of praise of the lecturer, to mention as a matter of little consequence, in view of his praises, that all of the devices, windings, etc., described were very old, and that the windings especially were attributed to Weston. I was considerably surprised at this, although Weston is entitled to more credit than he usually receives for being the inventor of much that is good.

Among other thing, Mr. Dunn explained what is known as the four pole, two brush or two circuit winding for drum armatures and its mate for ring armatures, and in view of the fact that the Crocker-Wheeler Electric Company have spent much time and a great deal of money investigating the merits and true ownership for these windings and securing the rights to them from abroad, I was surprised to hear them attributed to Weston, especially as I was not aware that he had ever done much in multipolar construction.

I was immensely pleased with the spontaneous outbursts of praise from a number of prominent gentlemen, amounting almost to an ovation. I can justly add that the conscientious ability of the lecturer has contributed very materially to the success of our company. Yours truly,

Schuyler S. Wheeler.

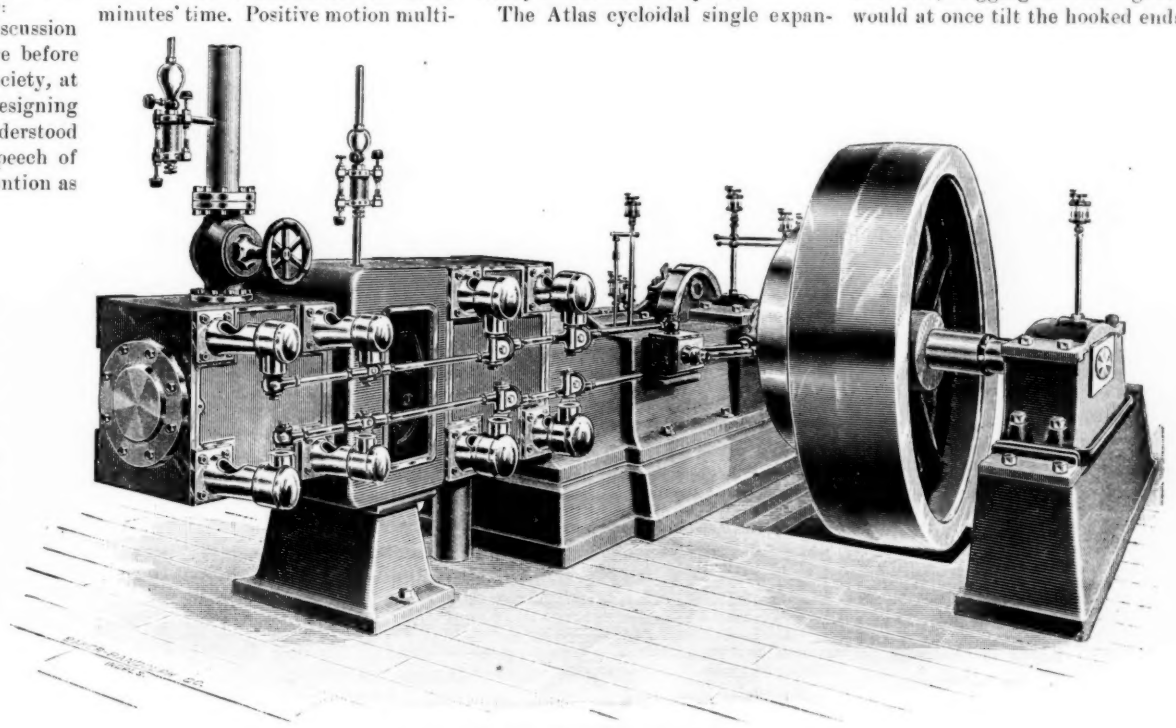
New York, December 10.

The DeKalb avenue electric line in Brooklyn is said to be one of the best paying street railways in the country. It is most ably managed, to the satisfaction of an immense number of patrons every minute in the day. This is literally true, for the cars are run on one minute headway during the rush hours morning and evening.

The Atlas Cycloidal Heavy Duty Engine.

The Atlas Engine Works, of Indianapolis, Ind., have recently developed a high class heavy duty engine which they have called the "Atlas cycloidal" and which is shown in the accompanying illustration.

The cylinder is a four valve cylinder with shortest possible ports; there is a live steam jacket to prevent condensation; the valve seats are removable for inspection or renewal, and the cylinder lining is removable for repair or renewal, affording important convenience for increase or decrease of cylinder diameter to a reasonable degree. The steam valves are multi-ported, flat surfaced, tight wearing, quick opening, short traveling; they are operated for any port opening by the least motion of a simple cycloid; are closed by steam pressure; and are without motion when under heavy pressure, and removable for examination in three minutes' time. Positive motion multi-ported exhaust valves are provided, operated by a fixed eccentric, maintaining uniform compression under all load variations. They are removable the same as the steam valves for examination or exchange for new parts.



Atlas Cycloidal Heavy Duty Engine.

The mechanism operating the valves is stripped of all crab claws, trips and dash pots. Rods direct from the governor and two eccentrics work in lateral motion simple cycloids for the steam valves and cranks for the exhaust valves. All are made of closest steel, are free from perceptible wear, are boxed in oil, conveniently accessible for care, with but very light duty. Every part is constructed in the most particular and best manner known.

A heavy locomotive main cross head of abundant weight to take the impact of steam on the piston equalize the pressure on the crank pin, and diminish the wear upon the piston and cylinder, is used. Direct connection between eccentrics and valve rods is provided, and there are no rock shafts. Diminution of wear is attained by the mounting of one slide upon the other. Only the differential motion occurs between the two. The connecting rod is a plain heavy strap joint rod. The strap is the special feature. No parts are strained by bending. It is built up of two sides and one end piece. Tenons on the ends, equal in strength to the sides, take the entire strain. The through-going bolts merely hold the parts together.

A removable main bearing is used whose diameter equals in inches one-half the cylinder diameter and whose length measures the same as the full diameter of the cylinder, the frictionless journal box of which can be taken out for renewal by simply jacking up the shaft and wheel. A strong roller bearing shaft governor of the inertia or dead wheel form controls the light weight, non-resisting balanced valves with so little effort that there is practically no variance in speed.

The Atlas cycloidal single expansion engines are made in eight sizes, from 100 to 400 rated horse-power. They are also made in the same sizes for double expansion—tandem compound—for 100 pounds, 125 pounds and 150 pounds steam pressure.

A Direct Connected Arc Light Plant.

To the Editor of Electrical Review:

The first directed connected arc light station in the United States was started on the night of December 17 at the Mutual Electric Light and Power Company's plant in Chicago. The new plant consists of a Willans engine connected directly to a 125 light Brush arc dynamo running Brush-Adams lamps. This marks a new era in electrical progress. Yours truly,

L. H. Rogers.

Cleveland, O., December 19.

An electric railroad between Sharpsburg, Mt. Sterling and Clay City, Ky., is talked of.

A New Trolley Hanger.

H. H. Ashley, of Springfield, Mass., has invented a new form of hanger intended to suspend the trolley wire from the cross wire between the poles. It has two important features. One is that the hanger does not support the trolley wire unbroken, as do those at present in use, but while it is of copper, and therefore carries the current, it receives the ends of the sections of trolley wire, without joining them together. The trolley is thus cut into sections equal to the distance between two poles; that is, about 125 feet. The other feature of the new hanger is that the end of the trolley wire is bent over in such a way as to form a kind of sliding hook, which, although it is held firmly so long as the trolley wire is unbroken, on the occurance of a break, allows the end of the wire to drop to the ground. If a break occurred at any point on the line, therefore, the broken ends of the wire, sagging to the ground, would at once tilt the hooked ends at the points of support, and, releasing them from the hangers, allow both pieces of the wire to drop, thus cutting out the whole section between two cross wires and averting all danger from hanging live wires.

LITERARY.

Captain Henry King, editor of the St. Louis *Globe-Democrat*, has written a most interesting article for the January *Forum* on "The Pay and Rank of Journalists," telling what journalists are paid in the principal news centers of the United States, comparing journalism as a career with other careers, and briefly sketching the wonderful growth of newspapers in this country since their first beginning in 1690.

A young man was crowded through the door of a Milwaukee street car, his hat was slightly damaged, and he thought a $100 bill from the street railway company would about satisfy him. He's still dissatisfied.

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No, Anxious Subscriber, no; telephone service is not free yet!

The parent telephone company at Boston will hear from its children right off, and a Christmas gift of royalties or franchise stock will be expected in their stockings.

Our Boston correspondent related in a recent issue the complaints of Boston street car passengers against riding in cold cars. The West End Railway Company should attend to this matter at once. Their system is so often pointed out as an example of first-class electric railway service that it is not becoming to have this flaw in it. Pneumonia is more terrible than the heat-generated microbe.

The offices of the ELECTRICAL REVIEW are at 13 Park Row, New York city. Twice 13 is 26 which is the day of the month on which this issue appears and is also the consecutive number of this issue in the volume. The number of the volume beginning with our next issue is 26. Here is a sequence of numbers from which some reader may be able to cast our fate. The number 13 has always been lucky for us.

Philadelphia, the home of the Keely motor, is now blessed with an "inventor" by the name of McLaughlin, who has "turned the trolley upside down," according to his paid notices in the daily press of that brotherly city. McLaughlin has yet to become known in electrical circles and his conduit railway scheme has the earmarks of a fraud. A practical test would immediately prove or disprove the bombastic claims for this system, but in our judgment such a test is the one thing not desired by the promoters.

JOURNALISTIC ENTERPRISE.

The ELECTRICAL REVIEW was the only electrical journal that appeared on time last week with the announcement of the Berliner telephone decision, besides giving comment, names of attorneys, opinion of officials, etc. The usual methods of our slow-going contemporaries prevailed.

The *Electrical World*, by delaying some 36 hours and disappointing (?) the few readers who really do pay for it, managed to get in 15 lines, in which was the astonishing statement that the decision affected the telephone interests and the Patent Office!

Our chickory-tinted contemporary, the *Electrical Engineer*, realizing that haste makes waste, thought it over for two days and nights, and meanwhile held numerous councils to discover if the question was really an important one. Finally it took the bull by the horns and published the opinion without a word of comment, although an able editorial in the same issue was devoted to "Increased Speed in Ocean Telegraphy." But not a word about increased speed in Boston telephone decisions!

THE MICROPHONE FREE.

The decision of Judge Carpenter in the famous case of the Government *vs.* The American Bell Telephone Company, the substance of which was given our readers last week and the full text of which will be found in this issue, will be hailed with delight by the many telephone companies which have sprung into life since the expiration of the basic patent of Alexander Graham Bell. The magneto transmitter, although theoretically a superior instrument to the microphone in faithfully reproducing the composite character of sound waves, which determine the quality of speech, is only a faint talker and is, therefore, set aside in favor of the more powerful instrument.

The decision just made declares void the Berliner patent of 1891 containing claims covering all known forms of microphone, and therefore practically throws open to these new companies a much broader field of operation.

If this patent had been sustained it would have proven a powerful instrument in the hands of the Bell Telephone Company in prolonging their monopoly for a second period of seventeen years. To those who are familiar with the recent Supreme Court decision in the case of Eagle *vs.* Miller Manufacturing Company the decision was no surprise; that case formulated a new doctrine in patent law, namely, that a patent to the same inventor rendered void a subsequent patent claiming matter disclosed in the prior one. Judge Carpenter's decision is based on two points—that just mentioned is one; the other is that the patent was obtained fraudulently.

Precisely the same drawings appear in Berliner's patent of 1880 and that of 1891. The invention is one that commercially could be of absolutely no value, since it involves transmitting and receiving speech by metal buttons held in elastic contacts; it is one of those cases which most inventors would cast aside as utterly worthless; and yet although containing not a mention of carbon, it was susceptible of claims broad enough to control the whole art. We think the point of inoperativeness was raised in the proofs, but is not touched upon in the decision. The court holds as a second controlling point of its decision that the patent was fraudulently obtained. During the 11 years in which the case was before the Patent Office the proofs show that the agents of the Bell Telephone Company were constantly publicly pressing for the issue but privately shifting for delay, and the court holds that the anxiety for issue was not sincere.

The Bell Telephone Company will doubtless not be satisfied with Judge Carpenter's view and will carry the case to the Appellate Court. It seems scarcely possible, however, that the ground of prior anticipation, in view of Eagle *vs.* Miller, can be overruled. This is the first set-back this great corporation has had in its history. It was organized to promote one of the most marvelous inventions ever made; its business has been managed with a sagacity as great as the invention was clever. It still holds patents, however, which will prove a stumbling block to rival concerns. The telephone will now be applied to a greatly increased range of service and doubtless ways will be found by clever people to furnish a satisfactory exchange system.

Wall Street and the Electrical Stock Market.

Owing to a general balancing of the year's accounts the financial world, as reflected in Wall street this week, was very quiet. The market was almost entirely professional. Even this class failed to stir up any excitement. The shipment of $5,680,000 gold was the bear factor. The adjournment of Congress, carrying with it a postponement of the railroad pooling bill, rendered all interests inclined to play a waiting game. There was no change in fundamental conditions. Towards the close of the week there was an inclination to take the bull side for a turn.

General Electric stock has been very quiet around 35. The 5 per cent debenture bonds advanced to 92. I have good authority for the statement that the street railway business of the company is the largest in its history, and that November was the banner month. The returns for 1894 will show more business than in 1892, which was the largest previous year. The reduction of car equipment to $850 from $1,250 a year ago and $1,650 two years ago, largely stimulated the increased demand. However, a still more important factor is the substantial interests, who realize that apparatus can be bought 40 per cent cheaper than a year ago, and in all probability 25 per cent cheaper than a year hence. They are availing themselves of the golden opportunity to secure needed supplies. A point in substantiation of this is the fact that irresponsible and weak financial concerns are not buyers. It is rare, indeed, to hear in these days of a concern making application for financeering, in order to purchase equipment.

The question naturally arises as to the amount of profit which General Electric is making on this business. I am told that it is very good indeed, owing to the enormous decreases in cost of raw material, labor and operating expenses. A point in substantiation of this is the fact that the expenses of the railroad sales department of the company have been reduced from 20 per cent to 2 per cent.

General Electric declined Saturday 1½ points, to 33¼, under sharp bear attacks. I am told by an executive officer of the company that there are no unfavorable developments pending.

I understand that the Kings County Elevated Railroad Company, of Brooklyn, is making an investigation with a view of adopting electricity on its lines. It will equip the surface lines to Brighton Beach and Canarsie first. This road and Manhattan are both waiting until the practical operation of the Chicago Metropolitan West Side railroad before placing contracts. The last mentioned is equipped by General Electric and will be running inside of a month.

I learn that the lines between Chicago and the East are seriously considering electricity as a motive power in order to reduce their costs so that they can compete with the lake lines on grain rates. The expense of transporting a bushel of wheat from Chicago to Buffalo is three cents. By rail it is seven cents. This is why the latter system of transportation is losing the business. All grain that is sufficiently good is being put into elevators, where it will remain until May, or until the opening of navigation. Investigation has already been made as to the feasibility of using the Niagara power for motive purposes between Buffalo and a point westward on the lines.

The price of Edison Electric Illuminating of New York reacted from the high figures of last week to 101¼. The 5 per cent debenture bonds also declined fractionally. The annual meeting of this company will be held on January 15. The company has declared a quarterly dividend of 1½ per cent payable February 1. Books close January 4 and reopen February 2.

The Berliner telephone patent decision, noted in the ELECTRICAL REVIEW of last week, has created widespread interest in financial circles. The stock of the American Bell Telephone Company reflected the adverse nature of the news by a decline of 10 points on the day it developed. It did not rally. The real stability of the Bell company lies more in its excellent organization, thoroughly established, and the franchises which it possesses, rather than underlying patents. The decision is certain to develop competition. But this does not mean that there will not be room enough for all. The opening of the Brooklyn Bridge increased ferry traffic, while the Manhattan Elevated system added to the possibilities of the New York street lines. Progressive competition along new lines develops new business, and there is no logical reason to assume that this will not be the case in the telephone world the same as in any other.

The Consolidated Electric Storage Company, of Philadelphia, has declared a quarterly dividend of one per cent, payable January 10. Books close January 1 and reopen January 11. Subscription books for the new preferred stocks opened this week. Inasmuch as stockholders are asked to subscribe at 50 for a stock which can be had in the market at 35, it is probable that no subscriptions will be made. It is understood that the new issue of stock is really a forced subscription upon the largest stockholders, who thereby make their original stock more valuable. BAIN.

New York, December 22.

The E. S. Greeley & Company's Store Gutted by Fire.

Early on Sunday morning last the building occupied by the large electrical supply house of the E. S. Greeley & Company, at 5 and 7 Dey street, New York city, was badly damaged by fire. The origin of the fire is unknown. The flames spread through the building and it is probable that the loss from fire and water will be heavy. The firm is known to have carried insurance which will probably cover the loss.

From the American Bell Point of View.

TO THE EDITOR OF ELECTRICAL REVIEW:

You have been quoted in the Boston papers as stating that the Berliner decision was a severe blow to the patent strength of the American Bell Telephone Company. Your opinion is correct and adroit. You did not state that it would seriously hurt this company, and one so well informed in telephone matters as you evidently knew what you were saying.

Now, as to that "severe blow." The outcome was expected, although the impression here is that the next tribunal will reverse the decision. On that I place no great reliance. My idea is that the whole matter is vastly exaggerated. The company is now and has been for a long time in a position to monopolize the business, and that even without the help of the patents. Remember that the American Bell, the American Telephone and Telegraph (long distance), the Western Electric and all the licensee companies have been constantly acquiring telephone patents, covering all practical devices needed for exchange work, that they must control something like 2,000 electrical patents; and then consider on top of that that the American Bell controls the recent Edison transmitter patent, which has not yet been questioned as to its validity—in other words, that the powdered or granular transmitter is yet in a tight grasp. And bearing all these points in mind, with the additional facts that they have the business, possess the finest instruments, the most excellent long line construction, where is then the chance, I ask, for the new companies to get a decent living? It is all fine talk to say, "the telephone business is now open to the world;" but the fact remains that you will have (like Diogenes) to go round in daytime with a lantern to find the corner where to locate your new business. So far, so good. I have given you my own opinion, and you may take it for what it is worth.

TELEPHONIST.

Boston, December 20.

PERSONAL.

Mr. Frederick R. Case, the active and popular representative of the great bolt and nut house of Hoopes & Townsend, Philadelphia, was a New York visitor last week and extended Christmas well wishes to many friends in the metropolis.

W. Worth Bean, of St. Joseph, Mich., first vice-president of the American Street Railway Association, is one of the most enthusiastic advocates of electric traction in the country. He has large interests in this field and keeps abreast of all improvements.

The Stirling Company has severed its relations with Mr. John MacCormack, who formerly represented them in New York, and has turned the eastern territory over to Mr. Frederick A. Scheffler. The New York office of the company will remain as heretofore, No. 126 Liberty street.

ELECTRIC RAILWAY NOTES.

An agitation in favor of safety fenders for the street cars at Cincinnati has been started.

A continuous ride on electric railways can now be taken for about 35 miles in Philadelphia and suburbs.

The electric street railway company at Lima, O., persists in running its cars in violation of the State law, which requires them to be vestibuled, and the council has decided to prosecute them.

Representatives of the bondholders of the street railway lines of Sioux City, Ia., are conferring in relation to consolidating several of the companies. Three or four of them now in receivers' hands will probably be consolidated and their bonds replaced by stock. The elevated, cable and riverside roads are the ones moving in the matter.

After personally inspecting the proposed route, the town board of Islip, L. I., has granted the franchise for the new trolley line. The work is to be completed within two years, and the town will receive two per cent of the net earnings. It is proposed to continue the road across the Island, if permission can be obtained from the various town officials.

The Jasper County, Mo., Electric Railway Company has purchased 40 acres of land between Carthage, Mo., and Carterville, on Center Creek, for park and power house purposes. The Joplin Electric Railroad has been sold at trustee's sale for $35,000 to D. R. Powers, of St. Louis, the main stockholder in a company which will build a line from Carterville through Joplin to Galena to connect with the electric road from Carthage to Carterville.

Three Good Men to Sell "Habirshaw" Wires.

As officially announced on another page of this issue of the ELECTRICAL REVIEW, Mr. J. W. Godfrey, Mr. F. W. Harrington and Mr. J. B. Olsen have allied themselves with the India Rubber and Gutta Percha Insulating Company, of New York city, manufacturers of the well-known Habirshaw white core insulated wires and cables. All these gentlemen have recently resigned from the New York Insulated Wire Company, of which Mr. Godfrey was general manager for nine years. In his new connection, Mr. Godfrey will manage the sales department of the India Rubber and Gutta Percha Insulating Company, and Messrs. Harrington and Olsen will be his efficient assistants. The last named company is to be congratulated on securing the services of these gentlemen, all of whom are well known to the trade, and each of whom has a flattering record as a salesman. The ELECTRICAL REVIEW extends its best wishes for success to the company and to Messrs. Godfrey, Harrington and Olsen.

A Portrait in Colors.

The American Electrical Works, of Providence, R. I., is sending out a novel holiday surprise to its friends.

PRESENT AND PROSPECTIVE DEVELOPMENT OF ELECTRIC TRAMWAYS.

READ BEFORE THE SOCIETY OF MECHANICAL ENGINEERS, NEW YORK, DECEMBER 6, 1894, BY C. J. FIELD.

(Concluded from page 306.)

UNDERGROUND CONDUITS.

Underground conduits, or the placing of the trolley wire with all its feeders under the surface of the street, is the ultimate and desirable result to be obtained in our large city lines of electric traction, and cities are going to demand in the near future this method of service where the local conditions and requirements will warrant it. Underground conduits were attempted four or five years ago, but on account of insufficient experience, lack of engineering ability, or amount of money expended on the work, as well as a desire on the part of the company installing them to make them a failure, they were not in general successful. The first really successful underground conduit to be installed and operated was in Buda-Pesth, about seven or eight miles in length, and it is now being extended to 30 miles or more. The local conditions there were favorable, and the width of slot opening which was possible to be used there was not practicable in this country, owing to our wagon tires. We have had the past year one or two conduits introduced on similar lines in this country on a very small scale, at Chicago and Washington, and we will have within the next few months the introduction of a conduit, in one or two of our large cities, on a large commercial scale. The conduit to be most used will be one similar to a cable conduit, with the trolley conductors placed at the sides in the shape of a channel or angle bar or rod of iron or copper, which will be divided into sections and fed by underground feeders laid along the line of the road. Various types of shoes or brushes will convey the current from the trolley wire to the motors on the car. Such a conduit, we believe, will only be successful where it is made a double trolley conduit and not depending on the track for the return circuit.

The other type of conduit which may be used is one of the several which are operated on the closed conduit plan. None of these have been introduced on a commercial scale as yet. It is a very attractive method in many ways, also saving on the cost of construction of a cable conduit. There are numerous difficulties in regard to the electrical details which will have to be overcome before such a form of duct can be a success. The overhead line construction, though, will continue to be used in the majority of cases for many years to come, we believe, as the most practicable and best method for conveying the current to the motors. The cost of a well built trolley conduit in the form of a cable duct will, in most cases, exceed that of a cable duct on straight track, but less on curves and special work.

CARS AND THEIR EQUIPMENTS.

In the old horse car service the standard length of car body was 14 to 16 feet, and in open cars seven or eight benches. The added service done by the large electric roads brought about an increase in the length of cars, particularly in the closed cars. This was carried to an extreme by increasing the length of the cars to 26 and 28 foot body, with double truck. We have had a reaction on that length, and we believe the best standard of car for heavy city traffic, and the one which will give the least wear and tear on the roadbed, and also will enable the use of higher speed on suburban lines, is a car body from 20 to 24 feet in length—21 or 22 feet being the most desirable standard—and mounted on double trucks, with maximum traction on the driving wheels. Such a car body, with wide platforms—four to four and a half feet—with entrances on one side, with wide double doors, fills best, we believe, the general requirements of such a service. There is a strong objection to the use of 19 or 20 foot car bodies on a single truck with a six and a half to seven foot wheel base, as has been done in a number of cases. There can be only one result from such an equipment, and that is a rapid destruction of the car body and also the track. This pounding or destruction of the track on these single trucks has, to a considerable extent, been due to the weight of the cast iron motors and their rigid mounting on the car axle. This difficulty has been greatly lessened by the introduction of steel motors of about half the weight and the supporting of them by springs.

Open cars may be treated in a similar manner. Generally these open cars are used on a single truck; but, if of excessive length, a double truck should be used. The trucks generally used we have partially treated of in describing the car bodies. To a car body 17 or 18 feet in length a four wheel truck with a wheel base six and a half to seven feet, increased as much as the curves which exist on the line will permit, is the standard where that length of car body is used. The general diameter of the wheels now used is about 33 inches, and we have many forms of heavy built forged frames or steel pressed frames, with every possible arrangement of the spring base which can be devised to overcome the natural tendency of the car body to teetering when partly filled with an unequally distributed load of passengers.

MOTOR EQUIPMENTS.

The improvement in motors during the past seven years, since their first introduction, has been marvelous. The old seven and a half or 10 horse-power motor was a thing of pity, poor in its design both mechanically and electrically, and a continual worry and trouble to keep it in operation and service, the fields and armatures burning out every day, and the repair account on them running from three to six cents per car mile operated. Now if we turn to the present type of iron-clad slotted armatures and waterproof motors, with normal horse-power capacity, in the general type of motors of 25 horse-power, making equipment per car 50 horse-power, and built for any speed which is practicable on the service for which they are to be used, with a depreciation, wear and tear less than almost any other type of power machinery, we have, it seems, attained a commercial stage and development in this motor which it will be hard to excel. These motors are now equal to almost anything to which they may be put. Their capacity, economy and power are brought to a high stage of development, and their economical controlling and handling is managed by a controller stand which gives various combinations and arrangements of the motor fields and armature, which gives us complete control over the current under different conditions of service, and gives us an economy in current consumption which is away beyond the expectations of a few years ago.

POWER HOUSE.

From the mechanical engineer's standpoint, probably the most interesting part of the equipment of the electric tramway is the power house, and therefore we will try to give you a more careful and detailed description of its present development and arrangement. The one central idea of electrical engineers, in the early electric light and power station work, was to have them located in the center of the system, regardless of all other local conditions and requirements. Experience has shown us, in the broad treatment from an electrical and mechanical engineer's standpoint, that we want to take into careful consideration not only the electrical requirements as to the distribution of power, but also the possibilities of economical generation of that power from a steam engineering standpoint; therefore we give careful consideration at present to this matter. The general requirements are that a power station of any size or capacity should be so located as to generate, under the most economical conditions, the power which is to be used in the utilization of electricity, and the location to be such that the obtaining and handling of coal and water shall be at the lowest obtainable net cost. The capacity of the station should take into consideration the present requirements and immediate future expectations as far as can be foreseen, and as far as the resources of the company will permit on a commercial scale, and without depending too much on future prosperity.

The general basis of calculation of the horse-power required for a tramway system must take into consideration the local conditions of service, grades, curves, etc., but, in general, 15 to 25 horse-power per car equipment in use on the road is the general limit of a well-designed station, which will take into consideration the conditions for the continuous service and operation of the plant. A road of 100 cars would, therefore, require about 2,000 horse-power, which horse-power should be divided into, say, four units of 500 horse-power each. The number of units in any station should be the fewest number which will give a safe and economical division of the units, and in a station of this kind four or five units, according to the service and conditions, should be the standard. In the past we have had to be guided largely by the capacity and size of generators it was possible to obtain, but this question is now eliminated, and any capacity of generator which the engineer may call for and feel necessary to meet the needs of his case can be contracted for and built with a surety of success. Generators are now being built in this country up to 5,000 horse-power each. The general arrangement and character of power station building required for power plant is a well-designed one story fireproof iron, brick and stone structure, with trussed roof, traveling power crane in engine room, and convenient for the handling of coal, ashes, etc., which it may be possible to obtain. The method of connecting up the engine and generators in the early types of small generators was to belt them to small automatic engines, or else by countershafting. Both methods have their advantages and disadvantages. At present the tendency is large generators directly connected to the engine, whether automatic or Corliss, high, slow, or intermediate speed, such connection being made either by direct belting or directly mounting the generator on the engine shaft. The type of engine to be used on this service, we have found, must be equal in its requirements to that of rolling mill service, capable of standing the heaviest strains in the variation of the load, and also to give desirable closeness in regulation under these heavy changes, in order that our generators may be balanced with one another. There is probably no service which has done more to develop the steam engine in the last few years than railway and power service. The Corliss engine is being better and more heavily built, and being made to regulate more closely than it did in the past. The automatic or high speed engine has been developed from a light, unmechanical single valve engine to a heavy, substantially built double valve engine giving good regulation and good service up to certain sizes; and for our larger units we believe the alternate type will be an engine combining the advantages and uses of an automatic and Corliss engine, combining the advantages of both, and trying to avoid the disadvantages. Such an engine for general requirements, we believe, will preferably be a vertical, it giving better economy of space in large plants. As to the number of cylinders to be used in engines, it is generally acknowledged to-day that compound engines give the best results on railway work. Triple expansion, on account of the wide variation of load, have been found to be undesirable, and therefore cross or tandem condensing or non-condensing—preferably the former—are the standard to-day.

In boilers we have a wide range in style, size and capacity. The plain, old horizontal return tubular, 16 or 17 feet long, with three and a half or four inch tubes, is still filling general requirements in a large number of cases in a satisfactory manner where real estate has not to be purchased at an excessive cost, and where the steam pressure does not exceed 125 pounds. Such a boiler, made with good material, with a butt strap joint, gives us good service. Where the conditions are such that we require water tube or sectional boilers, we have a large variety to select from, many of them meeting our requirements and giving good service; but a number of them we find are giving a good deal of trouble and bother in their care and maintenance, and also in not giving good dry steam.

The generators, as we have indicated, have been developed from small units to any size machine desired, and we have now a machine which in its economy, durability, regulation, etc., cannot be excelled. A well-built machine with slotted armature, large commutator, carbon brushes, slow speed and self-oiling bearings, requires a minimum of attendance to its good working. These are built for direct belting for a slow speed, or direct connection for the various types of engines operating from 75 to 150 revolutions, according to the size of the units or type of engine to which it is to be connected, and they are being built from 100 to 1,500 kilowatts capacity.

CAR HOUSE.

A well-built and well-designed car house is of as much importance to such a system as its power house. Such a car house should be built to obtain minimum handling of cars and afford good facilities for the care and repair of the cars in regular service, and also to give a storage capacity for the cars which are not in regular service. Such a car house should be a fire-proof structure in every respect, and afford ready access and egress for the cars. The general form of the structure, whether one or two story, must be in accordance with the general conditions and requirements of each case, and be

equipped with repair shops and repair pits, as well as paint shop, etc.

OPERATING EXPENSES AND COST OF EQUIPMENT.

The old horse car road in large cities operated at a total cost of from 18 to 25 cents per car mile. One car mile is taken as the standard for operating expenses in our tramway service. The heaviest item in this operating expense was the question of power—that is, the care and maintenance of the horses, their feeding and the depreciation of the same. The average life of a horse on a well operated tramway road is five to six years, and the number of horses required per car from eight to 11, according to conditions and requirements. The cost of this power service was from eight to 11 cents per car mile. This is where the electric road has made its heaviest gains in the reduction of operating expenses. This item is reduced in power service to-day to a cost, under general conditions, ranging from one to one and a half cents per car mile. Is not this a marvelous gain in a few years, and does it not indicate and show the possibilities of the introduction of this power on this service? The relative proportion of operating expenses to earnings in the horse railway service was from 70 to 80 per cent operating expenses to gross earnings. In electric service we have a considerable increase in our gross earnings over our old horse line, which increase runs from 25 to 50, and even 100, per cent in some cases, and the operating expenses being 40 to 60 per cent of the gross earnings. In this operating expense we include all the operating expenses of the road other than the fixed charges.

The cost of building and equipping an electric road is considerable. The last year or two has reduced this item to a considerable extent, especially on the electrical equipment; and has not only reduced the cost, but shows a great deal better equipment, and one which is going to show a much smaller depreciation than we had a few years ago. The standard price four years ago for an equipment of two 15 horse-power motors and the installation of them was $3,000 to $3,500. The price to-day for two 25 horse-power motors, which are much more superior to the former ones, is under $1,000. This gives us a total cost of a motor car, including car body, truck, motors, etc., of approximately $2,200. A single mile of roadbed construction, with 90 pound girder rail, exclusive of any new pavement, but including taking up of the old track and replacing of old pavement, about $7,500 per mile of single track. This makes no allowance for special work. Overhead line construction for one mile of double track, with iron poles, feeders, etc., $4,000 to $5,000 per mile; with wooden poles, about $3,000 or $4,000 per mile. Steam and electric plant for direct connected vertical compound condensing plant — for steam plant, $50 to $55 per horse-power, and the electrical, $20 to $25 per horse-power, making a total for steam and electric plant, $70 to $80 per horse-power. As a general summary, we have for the total cost of the equipment of the electric tram road—that is, the rebuilding of an old horse road—including power plant complete, buildings, car house, cars, equipment, track and overhead construction, $20,000 to $25,000 per mile of single track, according to the varying conditions and requirements of different cases.

CONCLUSION.

Without going to extremes, I believe we may safely say that the electric tramways have more than met all the requirements, expectations and agreements of even the most enthusiastic advocate during their early introduction, and when we look around us to-day and see the universal introduction which they have met with in this country, and are now meeting with in all parts of the world, we can in a measure appreciate what has been done in this matter.

As to the future and the future possibilities of the tramway, not only for city and suburban traffic, but also to enter into competition for a large share of the steam railway service, it will see the introduction of electricity for many purposes and uses in this field. The limit of speed and power obtainable is only limited by the conditions and local requirements of this service. Theoretically, any speed is possible which is desirable to be obtained on any service, and the only limits are the resistance of the wind or air. As to the exact line which this development is going to take, it is hard to determine; but we believe for a number of years to come it will be a continuance of the present lines, with improvements in the general detail of construction.

The storage battery we have left out of consideration entirely, and we do not believe it is in a state that it needs to be considered commercially as yet.

Up to the present time in this service our development has been with direct or continuous current. There is no question but that, with the large improvements and modifications which are being made in alternating current apparatus, we may expect its introduction on the tramway service, especially for long distance work.

In all this work the mechanical engineer has played and will play an important part, and the combined mechanical and electrical engineer is going to be and has been largely identified with the development of this line of work.

The Rhodes Hand Lathe.

The accompanying illustrations show the 12-inch hand lathe introduced by the L. E. Rhodes Company, Hartford, Conn., which has been designed to make with greater economy the small parts on electrical work. The especially valuable feature is a combination friction clutch and brake, by which the spindle may be instantly stopped or started by moving a small

FIG. 2.—HEAD BLOCK OF RHODES HAND LATHE.

lever, while the cone pulley is constantly revolving. This lever in the head block is arranged to operate by means of a very coarse-threaded screw, a hub keyed to the spindle and sliding laterally, which when forced in one direction by the lever engages a friction clutch of the ordinary type within the cone pulley, and, when moved in the opposite direction, brings the brake into bearing on the spindle, releasing the clutch. The workman in making his changes is, therefore, not obliged to touch the shipper, and saves the time ordinarily wasted while the lathe is slowing down, for the spindle is stopped instantaneously. Anyone doing lathe work requiring high speed and frequent stops or changes will appreciate the saving thus attained.

This lathe has hollow steel spindles, with adjustable brass boxes, etc., and bearing surfaces are carefully scraped. In short, it is a high-grade machine in every way. Those not needing the patent device can be supplied with the plain lathe, or with the draw chucks, heretofore used chiefly on watchmakers' lathes.

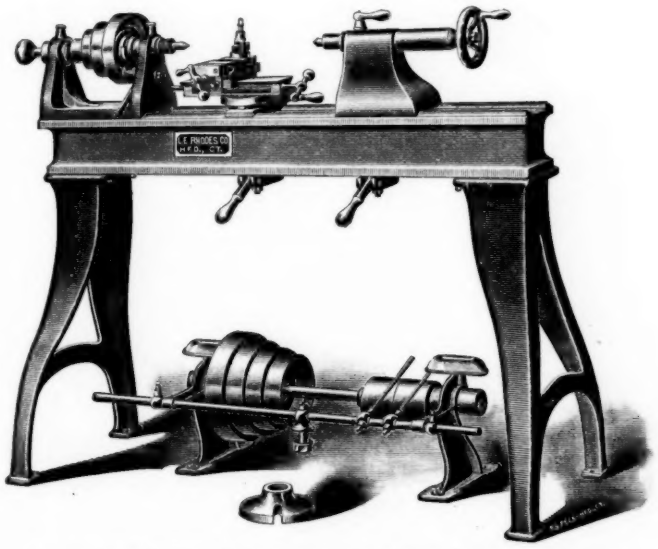


FIG. 1.—THE RHODES HAND LATHE, WITH NEW BRAKE AND CLUTCH.

Increase of Electric Light Signs.

There has been this season a great addition to the display of signs with letters formed of incandescent lamps; and such signs are now seen not only in Broadway, but in various other parts of New York city. They are displayed where signs would ordinarily be placed, and they are seen high in the air on lofty buildings. Indeed, there has never been a time when artificial light generally was so lavishly used as now.

Nikola Tesla as Viewed by a Layman.

A familiar figure at Delmonico's in the evening is that of a tall, well-knit, well-groomed man, swarthy, eagle-eyed, with a long nose, high cheek bones and a firm jaw, and with the air of being intensely interested in everything at which he looks. This is Nikola Tesla, man among men in the electrical world, a giant of discoverers, bold, original—a pathfinder whose every step is now being watched by all the scientific societies of the world. Where others have followed old theories and been hedged in by trammels of tradition, he has struck out at right angles, and startled the know-alls by showing that the laws of electrical force are still unwritten and unknown. His dynamo is radically different in construction and operation from any in use; his currents, while of vastly greater voltage, are innocuous; his system of lighting needs no filament of carbon or platinum, and gives out no heat; he can clothe himself in radiance like Phœbus, like Ajax; he can defy true thunderbolts, for he has tamed them while leaving their strength unshorn. All this and more has already been done, and yet the man has but little more than passed his thirtieth year, looks like a student, and has the unaffected simplicity of one whose thoughts never turn to self.—*Major Moses P. Handy in the "Mail and Express."*

The West End Street Railway Company and "Horse Equipment."

At the recent West End Street Railway's annual meeting the point was raised why "maintenance of horse equipment" in operating expenses was $130,225, an increase of $79,124 over the previous year, in the face of a decrease of 900 in the number of horses owned by the company. The explanation given by the Boston *News Bureau* is that the West End company has carried its horses on its books as worth $134 each. Whenever a horse is disposed of below that figure the difference between the selling price and $134 is charged to operation expenses under maintenance of horse equipment. The prices for horses have been so low the past year that the West End's loss on horses sold has been very heavy, and caused the increase in maintenance of horse equipment, over which the question was raised.

The Brooklyn, N. Y., Common Council, recently, by a vote of 11 to 6, refused to adopt a report of the Committee on Gas and Electricity, which authorized and directed City Works Commissioner White to prepare specifications and advertise for proposals to supply the city's streets and public buildings with gas and electricity for the year 1895, and to award the contract for the same. The only reason assigned for this action was that the City Works Commissioner should submit the proposals received to the Board of Aldermen for their consideration.

THE TELEPHONE QUESTION.

(*Concluded from page 312.*)

horde of manufacturers, large and small, into the manufacture of carbon transmitters of the Blake and kindred types—all of which instruments will use an induction coil. While the broad patent on the use of the induction coil expires next month, it is not generally known that the combination of any kind of a switch—whether automatic or not—with an induction coil is covered by a patent owned by the Western Electric Company (which company is controlled by the American Bell Telephone Company). This patent is known as the Watson patent of 1883, No. 270,522, dated January 9, 1883, and is one of the best trump cards of the Western Electric Company, whose counsel, Messrs. Barton & Brown, come pretty near knowing 'what is trumps.' The Colvin transmitter, as everybody knows, uses no induction coil. It will talk over a 10-foot circuit or a 1,000-mile circuit equally well without one; in fact it will talk better without a coil than with one. It will also stand any amount of electro-motive force from the voltage of one cell up to being placed directly across 110-volt mains. It has no adjustment, for the reason that it does not work on the principle of variable pressure. While this company is known as the Interior Telephone Company, we are doing a great deal of outside private line and exchange work. We already have in successful operation some nine or ten small exchanges, all of which are connected with trunk wires, and employ in their switchboards our patented drop and trunk line system. As to our interior systems we now have more than 250 buildings using them. I have recently designed and perfected a substitute for the multiple switchboard, something that must be had before any new company can successfully take care of the business of a large city exchange. This board is absolutely clear of all patents from the original Firman and Kellogg patents right down to the latest inspiration of Mr. Chas. Scribner. There is no such thing as a test circuit in this board; the operators' circuit is as simple as in the simplest old-fashioned 10-drop board; neither is there any likeness to what is known as the Sabin or 'express' system now used in San Francisco, and about to be adopted to some extent in Chicago. There will be no battery at any subscriber's station, neither will there be a magneto or other generator there. Nor will there be a constant current on the line. It is a system which I think will interest every new telephone exchange company and will be decidedly a move in the direction of simplicity. In the meantime it is not absolutely sure that the variable pressure battery transmitter is free until after the impending decision in the 'Bate case,' which may be expected early in 1895; nor is it certain until after the Berliner case shall have been taken to the United States Circuit Court of Appeals. Until both of these cases are decided we believe the public will be disposed to avoid all risk by using a transmitter such as ours, which does not operate upon the principle disclosed in the patents at issue in either of these cases."

OUR BOSTON CORRESPONDENT DESCRIBES THE SITUATION FROM A NEW ENGLAND POINT OF VIEW.

The great event of interest in electrical circles during the current week was the decision of Judge Carpenter in the Berliner patent suit, which was handed down on the 18th inst., and by which the Bell company received the most decided set back it has encountered thus far in its history.

While the outcome of the suit was very generally anticipated, and its results more or less hypothecated by those directly interested in the telephone business, the decision nevertheless created something of a sensation, and particulars were eagerly sought for. In this respect the ELECTRICAL REVIEW received much praise for its enterprise in getting out a special supplement and placing the salient features of the decision with comment before its many readers within a few hours of the time it was officially announced. It was quoted here quite extensively.

The effect of the decision was immediately felt on the floor of the Stock Exchange, where Bell Telephone stock fell off 10 points within an hour. This drop was only temporary, however, and before closing it had rallied several points and remained fairly steady.

The decision in this case is felt to be far reaching, more so than many people imagine, and aside from its vast importance in the telephone field, which may now be said to be practically wide open, it will exert more or less moral influence, at least, on pending issues in the lamp controversy, the decision of which is awaited with even more interest by the trade at large.

Judge Carpenter, in the text of his decision, has used some pretty plain language and criticised the methods of the Bell company in no measured terms. The duties of the Patent Office and of those having business with it are strongly set forth.

From the Bell company itself no statement of any kind can be obtained. From President Hudson down, the value of "golden silence" is fully appreciated, and no expression of opinion bearing on the case itself or its future influence on the telephone industry can be elicited. Beyond the fact that an appeal will be taken, they have absolutely nothing to say, and indeed there is little doubt as to the wisdom of this policy.

Those conversant with the situation, however, are looking forward to lively times and an immense increase in telephone service under the impetus of lower rates and the ownership of their own lines.

The Bell company is strongly intrenched in the large cities and in their magnificent long distance service, but the field now opened up for suburban exchanges, unhampered by heavy royalties to the parent company and free to devote a portion of their income to extending and improving their service, is one of practically no limit, and as the exchanges increase and multiply, eventually making their connections from town to town and from city to city, it is within the possibilities of the future for them, with the advantages of a comparatively small capitalization, and consequently lower rates, to make things exceedingly interesting for the Bell company, even on their own ground.

In any event, the decision just rendered will tend to increase largely the general use of telephones, and put them within the reach of many who have heretofore been obliged to do without them on account of the heavy expense attendant upon the service.

H. G. TUCKERMAN.

Boston, December 21, 1894.

THE LIVELY OPINION OF THE PRESIDENT OF THE WESTERN TELEPHONE CONSTRUCTION COMPANY.

TO THE EDITOR OF ELECTRICAL REVIEW:

It is fair to assume that the decision of Judge Carpenter, declaring the Berliner 1891 patent void, will be affirmed by both the Appellate and Supreme Courts, if the Bell company elect to take the case up higher, which they probably will for its commercial effect, if for no other reason. At any rate, it is settled for the immediate future, and the manner of its settlement has a more far reaching and effectual influence on the telephone business that may appear so closely following its accomplishment. Judge Carpenter's decision will result in giving greater impetus to telephone enterprises than the expiration of the fundamental Bell patents, for it is a noble notice to the world that the courts are still above the influence of private wealth and power. It removes also the undefined fear of monopolizing oppression, and capital will not hesitate to enter this lucrative field, from whence a waiting future stretches forth its welcoming arms. Telephone exchanges will be organized and pushed to completion, and telephone toll lines built with a freedom that promises well for the new year. Already the Western Telephone Construction Company inquiries show well in this direction, and expressions of satisfaction are heard on every hand.

Of course, it is to be kept in mind that the Berliner 1891 patent is not the only one to be feared, as there are several other patents of a hazardous character, including the 1880 Berliner patent referred to by Judge Carpenter as anticipating in identity the Berliner patent of 1891. These many device patents will make trouble for the many careless purchasers, or for the "patent pirates" that infest the electrical field particularly. Many of the telephones now being offered seem to have been gotten up without regard to some of these dangerous patents, and extreme caution in the selection of apparatus should obtain.

There will be "small-fry" imitators and gigantic telephone schemes presented to capture the unwary. It should be the mission of legitimate concerns to frown upon these parasites. The one causes a loss of faith in the character and efficiency of the apparatus and the other casts odium and doubt on the business from a commercial point of view. There is a good margin of profit in the business of operating telephone exchanges where none now exist, and the legitimate concerns will seek this business, while the promoter and stock-jobber will endeavor to unloose "the other fellow's" and fasten his own fangs through ordinances, etc., in the large cities. These efforts will result in extending and cutting into the business. Rates of rental must go lower, and much improved service be provided. Pushed to a close margin the Bell company must give up its royalty. The licensee companies will be unable to compete and pay bonus dividends, and this means trouble. Violation of contracts and litigation with the companies it has built up to individual monopolies will probably so occupy the Bell company in the next year or two, that it will have little spare time or energy to pursue competing companies. But it is said that the Bell long distance lines will still retain to them control of the business. This is idle and foolish! State laws will force the indiscriminate use of these long distance lines (as is now the case in Wisconsin) in every State in the Union. Then it is an eventuality that both the Postal and Western Union companies will furnish telephone "toll line service," as surely as that they will continue to exist. They cannot escape it any more than a railroad can get along without terminal facilities.

Briefly, the decison is gratifying in the extreme. J. E. KEELYN.

Chicago, December 18, 1894.

FULL TEXT OF JUDGE CARPENTER'S DECISION IN THE BERLINER CASE.

This is a bill in equity praying the repeal of Letters Patent No. 463,569, issued November 17, 1891, to Emile Berliner, as assignor to the American Bell Telephone Company, for combined telegraph and telephone.

The first ground of the bill to which I shall refer is that the patent is void, as being beyond the power of the commissioner to issue, in view of the issue of a former patent, No. 233,969, issued November 2, 1880, to Emile Berliner, for electric telephone. The patent of 1891 is for a transmitter for a speaking telephone. The fourth claim of the patent of 1880 is as follows:

"A system of two or more telephone instruments in electrical connection with each other, each consisting of two or more poles of an electrical circuit, in contact one with the other, connected with a vibratory plate, so that any vibration which is made at one contact is reproduced at the other, substantially as set forth."

This patent is, therefore, for the "system," or combination, of a transmitter and a receiver for a speaking telephone. The whole apparatus is shown in the drawings of both patents and is identically the same in both. The transmitter and the receivers are identical in form and differ in function according as they are placed at the transmitting or at the receiving end of the telephone wire. It therefore appears that one of the functions of the device shown in the patent of 1880, namely, the function of transmitting articulate speech, is identical with the sole object or function of the device covered by the patent of 1891, and that the device for affecting the transmission is identical in both patents. The patent, therefore, seems to me to be void and beyond the power of the commissioner to issue, Miller *vs.* Eagle Manufacturing Company, 151 United States, 186.

The second ground of the bill is that the issue of the patent was unlawfully delayed through the fault of the respondents. The respondent company was the owner of a patent previously granted to Alexander Graham Bell, which covered the art of electrical transmission of articulate speech. The device of Berliner, as both parties in this case agree, covers the only commercially practicable and useful method at present known for effecting such transmission. In this state of facts, the claim of the complainant under this bill is fully and briefly stated by counsel in the following words:

"The proposition is that the Bell Telephone Company intentionally delayed the prosecution of the Berliner application and the issue of the Berliner patent for the purpose and with the result of prolonging their control of the art of telephoning, which would cease with the expiration of the Bell patents, in 1893, and that they did this by submitting to delays on the part of the officers of the Patent Office, which delays they, the Bell company, had it in their power to prevent, and refrained from preventing, for an unlawful purpose."

This conduct is alleged to constitute a fraud practiced on the public through the Commissioner of Patents and his assistants, and it is claimed that the patent so obtained by such fraud may and should be annulled by the decree of the court on the authority of the United States *vs.* the American Bell Telephone Company, because there is no substantial difference between a fraud practiced upon the commissioner as an agent of the public and a fraud practiced upon the public with the commissioner's connivance or acquiescence. The application for the patent was filed June 4, 1877, and the patent was issued November 17, 1893. The patent of Bell expired in March, 1893.

The device covered by the patent in suit had been in public use by the respondent corporation since the year 1878. The respondent corporation was in ample means to prosecute the application. The result of any delay which might take place in the issue of the Berliner patent would evidently be to continue so much longer the practical monopoly of the art of electrical transmission of speech.

Under these circumstances I think it clear that the duty of the respondent corporation was to use the greatest degree of diligence in prosecuting the application to an early issue. There should have been, at least, as great diligence as their own interests would have called for, had their business been unprotected by patent rights.

Thus, there is no dispute between the parties here. It is admitted that the greatest diligence was incumbent in the respondent corporation, and that if there be unlawful delay, and that if there be bad faith and an intention to delay on the part of the applicant, then the patent may be here held to be void. From the filing of the application, June 2, 1882, it is not contended that there was any delay on which a decree here should be founded. There were delays in prosecuting the application, but they are said to be no greater than is usual in the Patent Office. On the date last given, the solicitor in charge of the application was notified by the examiner, as at present advised, it is believed, that the claims presented may be allowed, but final action in this case must be suspended, in view of probable interferences with other pending applications. In October, 1883, the solicitor wrote to the office asking that the case might receive attention, to which it was replied that the apprehended interferences had not yet been declared; and the correspondence was continued in the same sense until March, 1888, when the application was suspended until May, 1888, on the ground of the expected interference, and also for the purpose of awaiting the determination of the telephone case in the Supreme Court.

The application with which an interference was anticipated was that filed July 26, 1880, by Daniel Drawbaugh, in which he claimed to be the original and first inventor of the telephone. His claims were rejected on the ground that the instrument which he claimed to have invented had been in public use and was on sale for more than two years before the filing of his application. He had filed an affidavit in which he denied that there had been such public use with his consent and allowance. There was abundant evidence on file in the Patent Office by which was shown the fact of public use as early as July 26, 1878. It had been declared in Manning *vs.* Cape Ann Isinglass Glue Company that the statute then in force did not allow the issue when the invention had been in public use for more than two years prior to the application either with or without the consent or allowance of the inventor.

The case was then pending of the Bell company against the People's Telephone Company, owners of the alleged telephone inventions of Drawbaugh, in which was involved the question whether Drawbaugh had in fact invented the telephone at the early day claimed by him, or whether, on the other hand, his claim was entirely false. Under these circumstances there was set on foot a general understanding, as it is called, on the part of the examiner and the respective counsel for Drawbaugh and for the Bell company that the decision for the application for the Berliner patent should await the decision of the pending suit. There seems on the testimony no doubt that the Bell company fully acquiesced in this general understanding, and I think that in so doing it failed in its duty and committed a wrong against the public.

It was evident that in no case could Drawbaugh be entitled to a patent. He was clearly barred by the prior use of his invention. On the other hand, it is to be observed that the action versus the People's Telephone Company might not be finally decided for many years, and that when decided it would not necessarily throw any light on the question then pending in the Patent Office—namely, whether Berliner or Drawbaugh was the first inventor of the microphone transmitter. The suit was for infringement of two of the early patents issued to Bell, the first for electrical transmission of sound and the second for a receiver.

The answer denied the validity of the patents, alleged anticipations and further averred generally that Drawbaugh was the first inventor of the speaking telephone. The invention of the microphone, a particular form of the speaking telephone, was therefore not in issue. The case made by the People's Telephone Company, as was well known, was that Drawbaugh had invented the whole telephone system as it was then known, including the microphone, long before Bell's invention. If this were found to be the fact, then, of course, it would follow that he had anticipated Berliner as well as Bell. But if this were found to be the fact, that finding would throw no light on the question whether Drawbaugh had or had not invented the microphone subsequent to Bell, and prior to Berliner. It could never appear in the Patent Office that Drawbaugh was entitled to a patent, and only in one aspect of the telephone case could it be decided that Berliner was not entitled to a patent.

The plain duty of the respondent corporation was, it seems to me, to prove these claims on the Patent Office, and insist on its rights to a patent at once, leaving the question, which was pending in the courts to be settled whenever a final decision should be reached, and leaving the decision of that case to have whatsoever effect it lawfully might on the validity of the patent. The Commissioner on such an application might properly have been asked to take proofs on notice to Drawbaugh so as to ascertain prima facie, and with sufficient certainty for the purpose of an administrative decision, by whom the first invention of the microphone had been made. It would well have been urged on him that it was his duty to make such an investigation of a question which was not in issue in the pending suit, and which the decision of that suit might furnish no guide in determining.

It is objected that there was no established practice in the Patent Office, by which the question of priority of invention could be ascertained, and that for other reasons such an application to the Commissioner had no prospect of success. It seems to me clear that the duty of the respondent corporation was to test these questions rather than to consent that they must be decided against them, for an acquiescence in the delay seems to me to be no less than a consent that unfavorable result could come from the application.

That the unwarranted delay thus caused was intended by the respondent corporation I can have no doubt. In matters of this consequence, involving the whole business of a company of so large capital, and engaged in so large affairs, I cannot doubt that they were fully advised both as to the facts and as to the law; and I think their acts were so gross as to forbid any inference except that they dishonestly delayed the issue of the patent, taking advantage for that purpose of the perhaps excusable willingness of the officials of the Patent Office to postpone the decision of a sharply debated question in which a large public interest was involved, on a chance that a decision of the Supreme Court might supercede the necessity for a decision on their part.

In March, 1888, a final decision was rendered by the Supreme Court in the action against the People's Telephone Company, and the claim of Drawbaugh to the invention of the telephone was held to be unfounded. In June, 1886, the examiners-in-chief of the Patent Office had decided that Drawbaugh's application was barred by reason of two years' public use of the invention, and the time for an appeal from this decision expired in June, 1888.

The commissioner then set on foot a proceeding to determine whether in fact there had been a public use of Drawbaugh's invention for two years before the date of his application, and the Berliner application was still suspended to await the result of an interference which might be declared in case Drawbaugh should prevail in the public-use proceeding, the rule of the Patent Office being that no interference could be declared unless in cases where the interfering applicant, if successful in the interference proceeding, would be entitled to a patent.

The public-use proceeding, the purpose of which is to permit the applicant to be heard on the question of public use when that question has been raised by the office, was strenuously objected to by Drawbaugh, who took no evidence in the proceeding. In October, 1891, the proceeding came to an end by a final decision of the commissioner, to the effect that Drawbaugh was barred by the prior use of his invention.

On the next day the Berliner patent was ordered to issue, "largely because well settled principles of public policy forbid us to give any further opportunity for holding this application in the office."

There was no effort, as far as I can see, in the evidence on the part of the respondent corporation to prevent this further delay. There was ample evidence before the commissioner of the fact of prior use. The applicant, Drawbaugh, declined to take evidence in contradiction, and it seems to me clear that the respondent corporation should have urged upon the Patent Office a decision on the prima facie case which it had made.

I am persuaded that the delay thus caused, as well as the delay previous to the decision of the Supreme Court, was voluntarily acquiesced in by the respondent corporation. This seems to me the only conclusion from a consideration of the whole evidence. It is in proof that during the whole time from 1882 to the issue of the patent, and perhaps earlier, the solicitors of the Bell company were urgently insisting to the officials of the Patent Office that prompt action should be taken in the application. Even while the general understanding was in force to the effect that the application should await the decision of the Drawbaugh case in the courts, the evidence shows that these urgent applications were made to the Patent Office officials. I cannot think that it was by anyone expected that such oral applications should have any effect, unless, at least, they were made in support of formal applications made on the record, and, if formal, arguments and representations made in support of such application. The officers of the company also testify that at all times they were urgent in pressing for the issue of the patent. As to their state of mind and their actual intention at the time, I am free to say that I place less reliance on their statements now made than on a single statement made at the time. In February, 1886, while the general understanding was in force, Mr. Swan, one of the solicitors for the application, wrote as follows to the president of the Bell company:

"I am working the Edison and Berliner cases along quietly and think they will be granted by the examiner without interference or appeal, so that we can take them out by paying the final fees. We have six months to do that in."

This is but a single paragraph out of many hundreds of pages, but I think it shows clearly what was the purpose of the respondent corporation consciously formed by their officers and perfectly understood by their agents at the Patent Office. The application was to be "worked along quietly," although apparently pushed with great energy. There would be delay, but no substantial obstacle to the grant of the patent; and even after the patent should be ordered to issue there might be a further delay within the limits of the law and without imperiling the patent. If this latter does not mean this, I am at a loss to know what it does mean.

My conclusion, therefore, is that the complainant has made out the case, and that there should be a decree that the patent in question is void and shall be delivered up to be canceled.

The Edison Electric Illuminating Company, of New York, has declared a quarterly dividend of one and one-half per cent, payable February 1; books close January 4.

WHAT IS ELECTRICITY?

BY DR. P. H. VANDER WEYDE.

It is a very fortunate circumstance that our progress in the study of the nature of this wonderful force, and especially of its manifold practical applications, has by no means been dependent upon a correct answer to the great question of the day, which forms the heading of this article.

Two different answers have been given, each of which has its adherents. One answer is that electricity is a peculiar condition of ponderable matter; the other, that it is an imponderable fluid which experience has proved to be developed by certain manipulations or conditions to which we may expose suitable material objects.

If we follow the method which Tyndall adopted in his now famous book, entitled "Heat Considered as a Mode of Motion," we have but little difficulty to explain the phenomena of static electricity as a kind of a molecular strain, and the nature of voltaic electricity as a peculiar molecular motion, the quantity of electricity, measured in amperes, being conceived as a condition in which a great number of molecules partake in a moderate motion, while the intensity of the motion, measured in volts, can be conceived as a condition in which a lesser number of molecules partake in a more intense motion.

In order to grasp mentally the fact that many kinds of molecular motions can take place in the same molecules at the same time, we have only to consider that molecules are so infinitesimally small that they cannot exhibit the phenomena of momentum which are observed in large masses, and are proportionate to their size and weight. This momentum causes the axis of rotation of a large mass to retain a fixed position in space, which is not the case with the axis of rotation of molecules which are free from all the stress of momentum to which large bodies are subject.

These motions are transmitted from molecule to molecule; some kinds slowly, some with great rapidity. The motion which we call heat is transmitted through a conducting metallic rod at a very slow rate of speed, while the motion which we call electricity is transmitted with the most marvelous velocity.

The latter is evidently a rotation of the molecules around an axis parallel to the direction of the conducting wire, and which rotation is either right or left handed, like right and left hand screws, the right hand twist corresponding with the positive current, the left hand twist with the opposite or negative current. If this view is correct it will at once explain why the positive and negative electricities will neutralize one another, as necessarily the two opposite rotations must neutralize one another.

(To be continued.)

A local company has purchased the Denison, Ia., electric light plant for the sum of $16,000.

ELECTRIC LIGHT FLASHES.

The Charleston, Mo., electric light plant is to be sold.

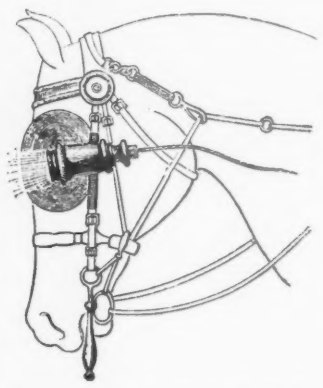
An attachment for $20,000, in favor of J. W. C. Morrison, and against J. T. M. Pierce, has been filed against the Yankton, S. D., electric light plant.

The Boston Electric Light Company has declared a quarterly dividend of $2 per share, payable January 15. Transfer books close December 31, reopen January 15.

The plant of the new Citizens' Electric Light and Power Company at Appleton, Wis., is nearly completed. An artesian well is being drilled to furnish the water.

The Seaforth, Ont., electric light plant, formerly run by the town, has been purchased by a joint stock company. The company is running 800 incandescent and 75 arc lights.

An ordinance granting to J. W. Raeder a franchise for an electric light and power plant in Cedarburg,



INCANDESCENT LAMP ON HORSES' HARNESS.

Wis., will be acted upon by the Common Council on December 28.

An agreement has been reached whereby the Union electric light plant of Union, Ore., is to pass into the hands of J. F. Phy. The title has been a matter of litigation for some time.

R. T. Wilson & Company, of New York, its largest creditors, bought the Hill City electric light plant at trustees' sale at Vicksburg, Miss., last week and will spend $10,000 in overhauling it.

The Edison Electric Illuminating Company, of Boston, last week voted to increase capital stock from $3,000,000 to $3,420,000. Stock will be offered to stockholders at par, one new share for six shares held.

A. W. Boardman has been appointed receiver of the Richmond Light, Heat and Power Company, of St. George, S. I. Suit had been brought by A. O. Beebe to secure a $15,000 mortgage. Mr. Boardman is endeavoring to obtain a voluntary dissolution of the firm.

At last week's meeting of the New York city Board of Estimate and Apportionment, F. C. Moore, representing a sub-committee of the Chamber of Commerce, asked for the appointment of inspectors of electric wiring. He wanted an appropriation of $17,000 for the purpose.

The officials of the San Jose, Cal., Light and Power Company have reason to believe that some enemy or enemies are engaged in a conspiracy to injure the company in its business. At different times of late the wires have broken in obscure parts of the city and it took hours to find the trouble.

The Detroit, Mich., Public Lighting Commission has received three dynamos from the Western Electric Company, of Chicago, and will set them up as soon as possible. There is a fourth which was used at the Michigan State fair, and the four are all that one engine can operate. The contract for these dynamos is not yet confirmed.

The City Council of Manitowoc, Wis., has passed a resolution by a vote of ten to four that the city own and operate its own electric light plant. The plant is owned by John Schuette, who had a five-year franchise, which has expired. It is doubtful whether the city will take hold of the matter, as the plant as conducted by Mr. Schuette has given satisfaction.

The Electrical and Mechanical Engineering and Trading Company, which got the contract to light the Brooklyn Bridge cars by electricity conducted into the cars from overhead wires, is at work suspending the wires over the tracks. The station from which the current will be conducted will be alongside the engine room on the Brooklyn side. The new lights will be in operation in about two weeks.

It looks very much as though the city electric lighting plant at St. Joseph, Mo., will have to go without a roof this Winter. A few days ago, when City Engineer Campbell advertised for bids for a slate roof, there was only one bid received, and that one was $146 higher than the appropriation. The city engineer then advertised bids on a tin roof. When the time for opening the bids came there was not a single bid in the engineer's office.

Incandescent Lamps for Horses' Harness.

In Berlin, Germany, the use of incandescent lamps attached to vehicles and the horses drawing them is said to be now so common as to excite no remark. An adaptation of the incandescent lamp for the latter purpose is shown in the illustration herewith, which is taken from London *Industries and Iron*. The lamp is enclosed in a silvered reflector, and is fed from a small battery of accumulators carried on the vehicle. The wires are enclosed in small guttapercha tubes sewn to the harness and made exceedingly flexible. The battery consists of four or six plates, having a capacity of 20 ampere hours. It is conveniently carried under the coachman's seat. The illustration shows only one of the numerous adaptations of the electric light for this purpose; others may easily be imagined.

American Institute of Electrical Engineers.

At the ninety-second meeting of the Institute, held at 12 West Thirty-first street, December 19, a paper was presented by Mr. Ludwig Gutmann, of Chicago, on "The Production of Rotary Magnetic Fields by a Single Alternating Current." In the absence of the author, the paper was read in abstract and the discussion opened by Dr. M. I. Pupin and continued by Messrs. Wolcott, Kennelly and Burnett.

At the meeting of council in the afternoon eleven associate members were elected and five associates were transferred to full membership. A committee was also appointed by the council to consider the question of an index of electrical literature. The committee is as follows: Prof. F. B. Crocker, chairman; Messrs. Edward Caldwell and A. E. Kennelly, Professors W. M. Stine and Geo. D. Shepardson.

Perpetual Motion in California.

It is reported from San Francisco that the directors of the Universal Power and Motor Company, which has been trying to develop a perpetual motor, the invention of Senor De La Torre, have levied an assessment of five cents. per share upon the capital stock to see if it won't make the machine work. Thus far the "motor" has not been very perpetual in its movements, and has demonstrated nothing of practical character, although plenty of money has been put up to make it a success. There has always been a missing link to the machinery. De La Torre, the inventor, is also missing. A short time ago, when the cash in the treasury gave out, he left for Mexico, and many members of the Italian colony who bought the stock are mourning his loss. They still have the machine, however, and will try with the five cent assessment just levied to make it run perpetually.

Suit on Edison Patents.

An answer to bills in equity in the suit of the Edison Electric Light Company against the Terminal Railroad Association, of St. Louis, for alleged infringement of patents used, was filed in the United States Court on December 14. The answer denies that Edison was the original inventor of an improvement in electrical distribution and translating systems, because he made his application for a patent on August 9, 1880, while others had precedence. Further, that it is not established by the plaintiff that Edison assigned his alleged patents to the Edison Electric Light Company. The gist of the whole matter is the broad claim by the defense that all of Edison's patents are null and void, because Edison was not the true inventor of such electrical appliances as are in dispute in this suit.

It is reported that owing to ill health, Mr. F. P. Little has disposed of his interest in the F. P. Little Electrical Construction and Supply Company, of Buffalo, N. Y.